

Brookhaven National Laboratory National Synchrotron Light Source		Number: LS-PPS-0039	Revision: A
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Subject: X21A1/A3 Radiological Interlock Test			
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Approved By:			

*Approval signatures on file with master copy.

[Revision/Periodic Review Log](#)

Test Reason:	Test Result: <input type="checkbox"/> Passed <input type="checkbox"/> Failed	
	Test Type: <input type="checkbox"/> Full <input type="checkbox"/> Partial	
Test Date:	Start Time:	Finish Time:
Tester 1:	Assistant 1:	
Tester 2:	Assistant 2:	

PREPARATION:

- Inform control room operator that test will be done. _____
- Turn off 'Red Tag' switch on x-ray ring interlock, and apply LOTO to X-Ray Security system. _____
- Verify that vacuum valves and water interlocks are satisfied or connect user interlock test jumper. _____
- Obtain Spare transfer Kirk Key 19370 and two spare beam pipe keys 19381. _____

[X21A1] (Downstream):

1.
 - Break security in the X21A3 hutch. _____
 - Move beam stop in X21A3 hutch to the "Out-of-Beam" position. _____
 - Ensure beam pipe is in place in the X21A3 hutch and both interlock connectors are made. _____
2. [Search Sequence] Search the X21A1 hutch
 - The overhead lights go out _____
 - The red interior light comes on _____
 - The audible alarm sounds for 13 to 15 seconds minimum _____
 - The hutch interlock sign turns on _____
3. Open hutch door
 - The hutch interlock sign goes out _____
4. Press CS-1, close hutch door and wait.
 - Hutch interior lights come on in not more than 30 seconds. _____
 - Press CS-E. _____
 - Interlock does not activate _____
5. Press interior search buttons in order, close door, press CS-E, note that alarm comes on, open and close door, press CS-E again. (This must all be done in less than the timeout interval noted in step 4)
 - Interlock does not activate _____

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6. Open photon shutter, if equipped. Search hutch, one person remains inside. Put hutch key in SRU and turn.

The Safety Shutter "enable" light does not come on until the end of the warning interval _____

7. Search X21A1 hutch. Attempt to search X21A3 hutch.

Cannot complete search _____

8. **[Emergency Stop]** Test the two Emergency Stops inside the X21A1 hutch
The person inside presses an Emergency Stop Button.

The shutter "enable" light goes out

The ES indicator comes on

The ES latch cannot be reset unless the SOR key is turned

Search hutch and repeat step 7 for each ES button.

ES1	ES2
_____	_____
_____	_____
_____	_____

9. **[Hutch door switches]** Place latch device on door lock so key can be removed. Place switch holders on door switches. Search hutch, put door key in SRU and turn, open safety shutter and photon shutter.

The "Beam On" sign turns ON _____

Door:			
1	2	3	4

Remove holder from switch 2.

RIB latch light comes ON

10. Replace holder on switch 2.

RIB cannot be reset unless SOR key is turned.

11. Remove holder on switch 1.

Safety shutter closes

Photon shutter closes

RIA latch light comes on

Hutch interlock drops out

"Beam On" sign goes out

RIA can't be reset w/o SOR

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

12. **[Beam pipe Test]**

Open Safety & Photon Shutter

Unplug **Upstream connector B**

RIB latch light comes on

Replace connector & Reset RIB

Open Safety & Photon Shutter

Unplug **Downstream connector B**

RIB latch light comes on

Replace connector & Reset RIB

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Unplug **Upstream connector A**

RIA latch light comes on _____

Safety shutter closes _____

Photon shutter closes _____

Replace connector & Reset RIA

Unplug **Downstream connector A**

RIA latch light comes on _____

Safety shutter closes _____

Photon shutter closes _____

Replace connector & Reset RIA

13. Obtain spare transfer key and, if applicable, beam pipe keys.

Open Safety & Photon Shutter

Place spare transfer key in beam pipe key transfer bank and turn

RIA latch light comes on _____

RIB latch light comes on _____

Safety shutter closes _____

Photon shutter closes _____

Reset Faults

14. [**Hutch SRU**] Replace holder on switch 1. Search hutch, leave shutter closed.

Hutch Kirk key (KKH) cannot be removed from SRU unless button is pushed _____

15. Open safety shutter and photon shutter.

KKH cannot be removed even if button is pushed _____

16. Close shutters. Turn KKH and note where solenoid unit stops rotation. Push the button and turn key just beyond this point, but not far enough to actuate "key removed" switch. Release the button and leave key in this position. Open shutter(s), remove KKH, and replace.

RIA latch light comes on _____

RIB latch light comes on _____

The safety shutter closes _____

The photon shutter closes _____

17. [**Beamline Transfer Key SRU**] With hutch interlocked, leave shutter(s) closed.

Beam line transfer key can be removed only if
button on SRU is pushed _____

Open safety shutter. (Photon shutter remains closed)

Beam line transfer key can't be removed even if
button is pushed _____

18. Close safety shutter.

"Cheat" SRU as described in step 13. Open safety shutter, remove the key and replace.

RIA latch light comes on _____

RIB latch light comes on _____

The safety shutter closes _____

SPA comes on _____

SPA can't be reset w/o SOR _____

Reset RIA and RIB

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19. **[Emergency Stop]** Open photon and safety shutter. Press an emergency stop button inside X21A1 hutch.

RIA latch light comes on
RIB latch light comes on
Hutch interlock drops out
ES indicator comes on
Safety Shutter Closes
Photon Shutter Closes

20. **[Photon Shutter Operation]** Observe the photon shutter while it is opened and closed.

The mechanism moves freely and without hesitation _____

20. **[Reach-Back]** One person goes to the x-ray equipment area and resets the indicators for RIAX and RIBX at SR100.

Open the safety shutter and photon shutter.

Remove switch holder from door switch number 2.

RIB latch light comes on
RIBX "Loop Enabled" indicator goes out
RIBX "Loop Disabled" indicator comes on

Replace switch holder.

RIBX cannot be reset

Reset RIB

RIBX CAN be reset
("Loop Enabled" indicator comes on)

21. Remove holder from door switch 1.

RIA latch light comes on
RIAX "Loop Enabled" indicator goes out
RIAX "Loop Disabled" indicator comes on
The safety shutter closes
The photon shutter closes (if equipped)
RIAX cannot be reset

Reset RIA

RIAX CAN be reset
("Loop Enabled" indicator comes on)

22. Remove the holders from the switches. Remove the latch device from the door lock(s). Stand inside the hutch and open and close the door.

All door switches operate freely and each makes a "click" when door is opened

(Complete test for each set of door switches)

Door:			
1	2	3	4

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[X21A3] (Upstream):

23.
 - Break security in the X21A1 hutch.
 - Ensure beam pipe is out of place in the X21A3 hutch.
 - Move beam stop in X21A3 hutch to the "In-Beam" position.
24. **[Search Sequence]** Search the X21A3 hutch
 - The overhead lights go out
 - The red interior light comes on
 - The audible alarm sounds for 13 to 15 seconds minimum
 - The hutch interlock sign turns on
25. Open hutch door
 - The hutch interlock sign goes out
26. Press CS-1, close hutch door and wait.
 - Hutch interior lights come on in not more than 30 seconds.
 - Press CS-E.
 - Interlock does not activate
27. Press interior search buttons in order, close door, press CS-E, note that alarm comes on, open and close door, press CS-E again. (This must all be done in less than the timeout interval noted in step 26)
 - Interlock does not activate
28. Open photon shutter, if equipped. Search hutch, one person remains inside. Put hutch key in SRU and turn.
 - The Safety Shutter "enable" light does not come on until the end of the warning interval
29. Search X21A3 hutch. Attempt to search X21A1 hutch.
 - Cannot complete search

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- 30 **[Emergency Stop]** Test the two Emergency Stops inside the X21A3 hutch
The person inside presses an Emergency Stop Button.

The shutter "enable" light goes out
The ES indicator comes on
The ES latch cannot be reset unless the SOR key is turned
Search hutch and repeat step 29 for each ES button.

ES1	ES2
_____	_____
_____	_____
_____	_____

31. **[Hutch Door Switches]** Place latch device on door lock so key can be removed. Place switch holders on door switches. Search hutch, put door key in SRU and turn, open safety shutter and photon shutter.

The "Beam On" sign turns ON _____

Door:			
1	2	3	4

Remove holder from switch 2.
RIB latch light comes ON

32. Replace holder on switch 2.
RIB cannot be reset unless SOR key is turned.

33. Remove holder on switch 1.

Safety shutter closes
Photon shutter closes
RIA latch light comes on
Hutch interlock drops out
"Beam On" sign goes out
RIA can't be reset w/o SOR

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34. **[Backstop Test]**

Open Safety & Photon Shutter

The A3 back stop must be in place when the pipe is removed. Place a latch device on the back stop Kirk key to remove the key, place holders on the A and B back stop switches.

Place the back stop key in the transfer unit and rotate.

Search A3 hutch. Open photon and safety shutter.

Remove holder on the backstop "B" switch.

RIB latch light comes on

Replace holder & Reset RIB

Remove holder on the backstop "A" switch.

RIA latch light comes on

Safety shutter closes

Photon shutter closes

Replace holder & Reset RIA

35. Open Safety & Photon Shutter

Place spare transfer key in Backstop key transfer bank and turn

RIA latch light comes on

RIB latch light comes on

Safety shutter closes

Photon shutter closes

Reset RIA & RIB

36. **[Hutch SRU]** Search hutch, leave shutter closed.

Hutch Kirk key (KKH) cannot be removed from SRU unless button is pushed

37. Open safety shutter and photon shutter.

KKH cannot be removed even if button is pushed

38. Close shutters. Turn KKH and note where solenoid unit stops rotation. Push the button and turn key just beyond this point, but not far enough to actuate "key removed" switch. Release the button and leave key in this position. Open shutter(s), remove KKH, and replace.

RIA latch light comes on

RIB latch light comes on

The safety shutter closes

The photon shutter closes

39. **[Emergency Stop]** Open photon and safety shutter. Press an emergency stop button inside X21A3 hutch.

RIA latch light comes on

RIB latch light comes on

Hutch interlock drops out

ES indicator comes on

Safety Shutter Closes

Photon Shutter Closes

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40. [**Shutter Enable Key**] Open the safety shutter. Remove the Control Room Shutter Enable Key for this beam line, and then replace the key.

The safety shutter closes _____
RIA latch light comes on _____
The "Control Room Shutter Enable" light goes out _____
The SPA latch comes on (after the key is back on) _____
The safety shutter cannot be opened _____

Reset RIA and SPA

41. [**Auto Open**] Open the Safety Shutter.
Turn "Auto Open" key to "ON".
At the Control Room Operator's Console, switch the shutter master enable to "Inhibit" and back to "Enable"

The safety shutter closes _____
And then re-opens _____

Turn "Auto Open" key to "OFF"
Switch the master enable to "Inhibit" and back to "Enable"

The safety shutter closes _____
And does NOT re-open _____

42. [**Reach-Back**] One person goes to the x-ray equipment area and resets the indicators for RIAX and RIBX at SR100.
Open the safety shutter and photon shutter.
Remove switch holder from door switch number 2.

RIB latch light comes on _____
RIBX "Loop Enabled" indicator goes out _____
RIBX "Loop Disabled" indicator comes on _____

Replace switch holder.

RIBX cannot be reset _____

Reset RIB

RIBX CAN be reset
("Loop Enabled" indicator comes on) _____

43. Remove holder from door switch 1.

RIA latch light comes on _____
RIAX "Loop Enabled" indicator goes out _____
RIAX "Loop Disabled" indicator comes on _____
The safety shutter closes _____
The photon shutter closes _____
RIAX cannot be reset _____

Reset RIA

RIAX CAN be reset
("Loop Enabled" indicator comes on) _____

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44. Remove the holders from the switches. Remove the latch device from the door lock(s). Stand inside the hutch and open and close the door.

All door switches operate freely and each makes a "click" when door is opened

(Complete test for each set of door switches)

Door:			
1	2	3	4

45. [**Safety Shutter Operation**] Search the hutch. Locate the safety shutter associated with the beam line by tracing the beam pipe through the shield wall. Do not rely on labels on the shutter mechanism. Open the shutter.

The correct shutter opens

No other shutter at that saw tooth opens or attempts to open

Close the safety shutter.

The mechanism moves freely and without hesitation

46. Remove user interlock test jumper (if applicable).

* * *

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